

the fade-out ranges must be charged. The data in the other subchannels are not altered in the process. For this purpose, the data to be transmitted may be fed at the input of the processing unit 4' and, at the output of the processing unit 4', the subcarriers contained in the fade-out range and the thereto adjacent subcarriers with a charge compensating the side lobes may be detected, whereas these subcarriers may be read by the IDFT-unit 1 together with the unaltered charges of the remaining subcarriers located outside the fade-out range. In unit 2, the parallel data are converted into a serial transmitter signal.

As a result thereof, the side lobes occurring in the frequency intermediate ranges is calculated for each frequency range extending between the subcarriers contained in the fade-out range and the thereto adjacent subcarriers which yields the required charge of the subcarriers contained in the fade-out range and the thereto adjacent subcarriers so that a compensation of the side lobes occurring in the fade-out range is obtained, the subcarriers contained in the fade-out range and the thereto adjacent subcarriers being transmitted with the computed charge and the remaining subcarriers remaining unaltered. To demonstrate the method according to the invention, three examples were calculated for a VDSL transmission route. 10.5 MHz was selected as a Nyquist frequency. The analogous transmission filter circuit has a passband of 0.3 MHz to 10.1 MHz. Three amateur radio bands are located within this range, namely 1.81 MHz - 2.00 MHz, 3.50 MHz - 3.80 MHz and 7.00 MHz - 7.10 MHz.

The examples according to the Figs. 21 - 24, Figs. 25 - 28 and Figs. 29 - 32, in which the achieved power density spectra are illustrated, show a possibility of suppressing the amateur radio bands with the method according to the invention, the power density spectrum must be lowered to below 0.3 MHz or to above 10 MHz respectively by means of the analogous transmission filter circuit and is not further taken into consideration. The number of the channels M amounts to 512 (Figs. 21-24), 1024 (Figs. 25-28) and 2048 (Figs. 29-32). The areas with a grey background represent the various amateur radio bands, Figs. 22-24, Figs. 26-28 and Figs. 30-32 being enlargements of the fade-out ranges.

The parameters for the various ranges are indicated in the following charts. The first column indicates in which subchannels a compensation pulse is transmitted. The second column states

which subcarriers are used for generating the compensation pulses and are not charged with information symbols. If the method according to the invention is not made use of, the channels indicated in the last column must be charged with zero.

	compensation pulses	needed subchannels	set to zero
1 st band	$k = 43, 44, \dots, 49$	$k = 42, 43, \dots, 51$	$k = 37, 38, \dots, 56$
2 nd band	$k = 85, 86, \dots, 92$	$k = 84, 85, \dots, 94$	$k = 79, 80, \dots, 99$
3 rd band	$k = 170, 171, 172, 173$	$k = 170, 171, \dots, 174$	$k = 163, 164, \dots, 180$

$M = 512$

	compensation pulses	needed subchannels	set to zero
1 st band	$k = 87, 88, \dots, 97$	$k = 86, 87, \dots, 99$	$k = 82, 83, \dots, 103$
2 nd band	$k = 170, 171, \dots, 185$	$k = 168, 169, \dots, 188$	$k = 165, 166, \dots, 191$
3 rd band	$k = 340, 341, \dots, 346$	$k = 339, 340, \dots, 347$	$k = 335, 336, \dots, 353$

$M = 1024$

	compensation pulses	needed subchannels	set to zero
1 st band	$k = 176, 177, \dots, 195$	$k = 175, 176, \dots, 197$	$k = 171, 172, \dots, 200$
2 nd band	$k = 341, 342, \dots, 349$ $363, 364, \dots, 371$	$k = 339, 340, \dots, 373$	$k = 336, 337, \dots, 376$
3 rd band	$k = 682, 683, \dots, 692$	$k = 681, 682, \dots, 694$	$k = 677, 678, \dots, 698$

$M = 2048$

In all of the three examples, the lower most and the central subcarriers are not charged. This zero setting is not needed for fading out the amateur radio bands but is intended to reduce the power

density spectrum of low and high frequencies.

For the symbols of the subcarriers $M/2+1$ to $M-1$, $A_l = A_{M-l}^*$, $l = M/2+1, M/2+2, \dots, M-1$. This charging regulation is necessary for a real transmitter signal.

In the third example (Figs. 29 - 32), the second amateur radio band is allocated the channels 341 to 370. Compensation pulses are only devised for the subbands 341, 342, ..., 349, 363, 364, ..., 371, though. In the central subchannels the interferences are already attenuated enough, compensation pulses do not have to be employed.

The calculation of the compensation pulse will be indicated herein after.

It may be shown that the energy of a pulse response of a filter in a frequency range of θ_1 to θ_2 may be represented as a square form. The pulse response $s(n)$ be M taps long so that the energy E_s is defined as

$$E_s = \frac{1}{2\pi} \int_{\theta_1}^{\theta_2} s^* \psi^*(e^{j\theta}) \psi^T(e^{j\theta}) s \, d\theta = \frac{1}{2\pi} s^* \int_{\theta_1}^{\theta_2} \psi^*(e^{j\theta}) \psi^T(e^{j\theta}) \, d\theta s = \frac{1}{2\pi} s^* \Theta(\theta_1, \theta_2) s \quad (7)$$

$s = [s(0)s(1) \dots s(M-1)]^T$ is the pulse response, $\psi(e^{j\theta})$ is

$$\psi(e^{j\theta}) = [1 \, e^{-j\theta} \, \dots \, e^{-j\theta(M-1)}]^T. \quad (6)$$

whereas

$$\Theta(\theta_1, \theta_2) = \int_{\theta_1}^{\theta_2} \psi^*(e^{j\theta}) \psi^T(e^{j\theta}) \, d\theta.$$